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(54) Title: SUBSCRIPTION HANDLER INTERFACE BETWEEN A CUSTOMER ADMINISTRATIVE SYSTEM AND DATABASE NETWORK ELEMENTS OF A COMMUNICATIONS NETWORK (57) Abstract <p>A customer administrative system (24) of a wireless communications system is interfaced with one or more system database network elements (26) to support a subscription handling functionality. A subscription handler service agent (30) is included in the interface (22) to process received orders concerning a subscription management activity or task. The interface (22) further includes a database (32) storing certain network over-view knowledge (network modeling) concerning the subscriptions maintained in the database network elements (26). The interface (22), through the service agent (30), updates the network over-view knowledge to record customer administrative orders and database network element responses relating to subscription management activities or tasks. Furthermore, utilizing the information comprising the network over-view knowledge, the interface (22), again through the service agent (30), evaluates each received order against the database stored network over-view knowledge, and responsive to such an evaluation operates to identify and intercept incoherent orders that are not understandable by, or are inapplicable to, the database network elements (26).</p>		

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**SUBSCRIPTION HANDLER INTERFACE BETWEEN A
CUSTOMER ADMINISTRATIVE SYSTEM AND DATABASE
NETWORK ELEMENTS OF A COMMUNICATIONS NETWORK**

5 **BACKGROUND OF THE INVENTION**

Technical Field of the Invention

 The present invention relates to communications networks and, in particular,
to an enhancement of the interface between a customer administrative system and
database network elements of a communications network to support a subscription
10 handling functionality.

Description of Related Art

 Reference is now made to FIGURE 1 wherein there is shown a block diagram
illustrating a portion of a communications network 10 implementing a prior art
transaction-based interface (IF) 12 between a customer administrative system (CAS)
15 14 and a plurality of database network elements (NE) 16. The interface 12, customer
administrative system 14, and database network elements 16 are interconnected using
a network 18 preferably comprising a network, such as an X.25 network, separate and
apart from the communications network 10. As an example, the communications
network 10 may comprise a wireless (for example, cellular) telecommunications
20 system, with each database network element 16 then comprising, for example, a
database storing permanent and temporary wireless subscriber data (e.g., a home
location register (HLR)). The permanent data stored in the database network element
16 comprises fixed information concerning the communications service subscribed
to by each subscriber. The temporary data stored in the database network element 16
25 comprises variable information, such as in the instance of a home location register
information concerning the current location of each subscriber.

 The customer administrative system 14 is utilized to engage in transactions
relating to the administration of the permanent data stored in each database network
element 16. These administration activities, in general, relate to transactions
30 performed for the purposes of customer (i.e., subscriber) creation or deletion, service
activation, and the like, relating to a given customer. More particularly, the
transactions relate to subscriber data administration tasks such as:

- subscription initiation/removal/status,
- subscriber activation/cancellation,
- 35 - service provision/withdrawal/activation/passivation,
- C-number (transfer) definition,

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- pass code changes, and
- serial number changes.

5 The transactions may further relate to authentication administration tasks such as authentication activation/change/deactivation/status. Additionally, the transactions relate to numbering plan configuration including number range assignment, numbering plan deletion and numbering plan viewing. To support these transactions, the customer administrative system 14 includes a database (not shown) for storing subscription and other related information.

10 By "transaction-based" it is meant that the interface 12 receives orders originated at the customer administrative system 14 and directed (i.e., addressed) to a particular one of the database network elements 16, converts those orders to a proper format for communication to and/or understanding by the addressed database network element, and routes the properly formatted orders to the addressed database network element. Similarly, the interface 12 receives any response to a transmitted order from
15 the addressed database network element 16, converts the response to a proper format for communication to and/or understanding by the customer administrative system 14 that originated the order, and routes to the originating customer administrative system. Thus, one order generated by the customer administrative system 14 which is sent through the interface 12 to an addressed database network element 16 produces one
20 corresponding response. The interface 12 accordingly functions in a non-intelligent routing fashion to simply pass information (orders and responses) back and forth between the customer administrative system 14 and the database network elements 16.

SUMMARY OF THE INVENTION

25 With continued reference to FIGURE 1, the prior art interface 12 does not keep any permanent or semi-permanent record of the customer administrative system 14 orders or the corresponding database network element 16 responses. Because no record is kept of the orders and responses, the interface 12 has no real-time knowledge of what information is stored (or should be stored) in the database network elements 16 for each subscription. There are a number of drawbacks which arise from the
30 failure to keep such records. First, in the event that a given database network element 16 does not support automatic roll-back following a failed customer administrative transaction, and when such a roll-back is needed for that given database network element, the interface cannot direct the roll-back and return the database network element to its prior state because it does not know what the state should be. Second,
35 the interface 12 cannot perform subscription audits without the assistance and involvement of the customer administrative system 14 which presumably has access

to the necessary information. There is a need then for a more intelligent interface capable of recording order and response information, and allowing these records to be utilized in supporting roll-back and audit operations.

It is also recognized that the prior art interface 12 does not have any network over-view knowledge (also referred to "network modeling") concerning the subscriptions maintained in the database network elements 16. By this it is meant that the interface does not understand the relationships between the following: the subscribers, their subscriptions, the included services within each subscription, the nodes of the network where service-related information is stored for each subscription, and the status of subscription and service activation. There are a number of concerns with respect to this deficiency. First, as discussed briefly above, due to the lack of access to this kind of information, the interface 12 cannot perform a roll-back or subscription audit without the assistance and involvement of the customer administrative system 14. Second, in some instances a customer administrative system 14 inadvertently may issue an incoherent order. By incoherent it is meant that the order is not understandable by, or is inapplicable to, the addressed database network element 16 based on the network over-view knowledge. An order may also be incoherent if it conflicts with another request received by that database network element 16 or conflicts with or must be processed in parallel with, for instance, a request made to another database network element. Because the interface 12 does not possess any network over-view knowledge, it fails to recognize that the order is incoherent, and simply blindly passes the order on to the addressed database network element. At best, node, interface and network communications resources are wasted in processing (and thereafter rejecting) this incoherent order. At worst, erroneous modification of stored information in the database network element 16 may occur as a result of order processing. In either case, this result is unacceptable, and there should exist some way for the interface to intelligently process the orders in accordance with some network over-view knowledge and intercept, before transmittal to the database network elements, any incoherent orders originated from the customer administrative system 14.

To address these and other drawbacks with the prior art interface, a present invention interface between a customer administrative system and one or more database network elements of a communications system includes a subscription handler functionality. In general, this functionality comprises a subscription handler service agent in communication with a database storing certain network over-view knowledge (network modeling) concerning the subscriptions maintained in the database network elements. The service agent accordingly has access to information

defining the relationships between subscribers, their subscriptions, the included services within each subscription, the nodes of the network where service-related information is stored for each subscription, and the status of subscription and service activation. The service agent functions responsive to a received order originated by the customer administrative system to permanently or semi-permanently record in the database network over-view knowledge comprising customer administrative system orders and any corresponding database network element responses. The service agent further functions responsive to a received order originated by the customer administrative system to evaluate the order against the database stored network over-view knowledge, and responsive to such an evaluation identify and intercept incoherent orders that are not understandable by, or are inapplicable to, the addressed database network element.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the method and apparatus of the present invention may be acquired by reference to the following Detailed Description when taken in conjunction with the accompanying Drawings wherein:

FIGURE 1, previously described, is a block diagram of a portion of a communications network implementing a prior art transaction-based interface between a customer administrative system and a plurality of database network elements;

FIGURE 2 is a block diagram of a portion of a communications network with a present invention subscription handler interface between a customer administrative system and a plurality of database network elements; and

FIGURE 3 is a nodal operation and signal flow diagram illustrating interface operation for handling customer administrative system requests.

DETAILED DESCRIPTION OF THE DRAWINGS

Reference is now made to FIGURE 2 wherein there is shown a block diagram of a portion of a communications network 20 implementing a present invention subscription handler interface (IF) 22 between a customer administrative system (CAS) 24 and a plurality of database network elements (NE) 26. The interface 22, customer administrative system 24, and database network elements 26 are interconnected using a network 28 preferably comprising a network, such as an X.25 network, separate and apart from the communications network 20. As an example, the communications network 20 may comprise a wireless (for example, cellular) communications system, with each database network element 26 then comprising a database storing permanent and temporary wireless subscriber data (e.g., a home

location register (HLR)) as previously described. Thus, the database network elements 26 store permanent data comprising subscriber communications service information, and temporary data comprising the current location of each subscriber. As another example, the communications network 20 comprises an Internet protocol (IP) type data communications network, with each database network element 26 then comprising an IP service node.

The interface 22 includes a subscription handler service agent 30 which supports not only conventional transaction-based processing in the same manner as the prior art interface 12 illustrated in FIGURE 1 and previously described, but also supports subscription handler processing in accordance with the present invention. A database 32 is provided for the interface 22 for storing certain network over-view knowledge (network modeling) concerning the subscriptions maintained in the database network elements 26. The service agent 30 is charged with overall subscription handling duties and thus coordinates customer administrative system 24 access to the database network elements 26 in the context of the stored network over-view knowledge. The service agent 30 accordingly functions to (a) store each received customer administrative system 24 order in the database 32, (b) identify for each order the database network element(s) 26 that must be accessed in order to implement the ordered activity, (c) identify the particular activation or management action(s) to be taken by each database network element in connection with that order, (d) identify the individual element specific command(s) needed to effectuate those actions, (e) determine whether each specific command presents a coherent request with respect to the identified database network element in view of the stored network over-view knowledge, (f) generate each of those coherent individual element specific commands in a proper format (i.e., tailored) for communication to and/understanding by the identified database network elements, (g) issue the individual element specific commands to each of those database network elements, and (h) store any responses received from the database network elements in the database, and sends the appropriate response to the customer administrative system. At each, the network model is modified as appropriate. Thus, for each received order, the appropriate ones of the plural database network elements 26 are identified and issued appropriately formatted and coherent individual element specific commands. The agent 30 further receives any response to the individual element specific commands from the network elements 26, converts the responses (if necessary) to a single response in a proper format for communication to and/understanding by the customer administrative system 24 that originated the order, and routes the properly formatted response to that originating customer administrative system.

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The database 32 stored network over-view knowledge defines the relationships between the following: the subscribers, their subscriptions, the included services within each subscription, the nodes of the network where service-related information is stored for each subscription, and the status of subscription and service activation.

5 The network over-view knowledge stored in the database 32 identifies for each subscriber the relationship between that subscriber and the services to which that subscriber is subscribed. Furthermore, the network over-view knowledge stored in the database 32 identifies any relationships between two services. An example of this may comprise the identification in the database 32 of a given service (such as flexible
10 call forwarding) in a relationship which requires the subscriber to simultaneously be subscribed to another service (such as unconditional call forwarding) in order for the given service to be implemented. Still further, the network over-view knowledge stored in the database 32 identifies the relationship between each service and the node(s), such as database network elements 26, on which that service is provided.
15 Additionally, the network over-view knowledge stored in the database 32 identifies the current status of service activations. An example of this is the storage of customer administrative system requests sent to a database network element and for which responses have not yet been received.

Reference is now additionally made to FIGURE 3 wherein there is shown a
20 nodal operation and signal flow diagram illustrating interface 22 agent 30 operation for handling customer administrative system 24 requests. The customer administrative system 24 sends a machine independent (i.e., generic) order 40 to the interface 22. The agent 30 stores the received order in action 42 in the database 32. The stored order accordingly becomes part of the database stored network over-view knowledge.
25 The agent 30 further identifies in action 44 which ones of the plurality of database network elements 26 need to be accessed in order to complete the requested service/subscription activation or management activity. To support the identification process of action 44, the agent 30 accesses the database stored network over-view knowledge concerning service, subscription and node relationships. The agent 30
30 accordingly recognizes for the received order which database network element(s) 26 needs to be communicated with in order to effectuate a service/subscription related activation or management task. Following identification of these implicated database network elements 26, the interface 22 next identifies in action 46 the particular action(s) to be taken by each database network element in connection with
35 implementing that received request 40. The actions to be taken may comprise, for example, activation or management actions to store certain data, modify certain data and/or delete certain data from each of the implicated database network elements 26.

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The interface 22 next identifies in action 48 the element specific commands which are needed to effectuate those actions by each of the database network elements 26. Once the commands are identified, the interface determines in action 50 whether each specific command (relating to the original customer administrative system order) presents a coherent request with respect to the identified database network element in view of the stored network over-view knowledge. The point of this processing action 50 is to identify whether the customer administrative system has inadvertently issued an incoherent order. By incoherent it is meant that the order (and/or its resulting command(s)) is not understandable by, or is inapplicable to, the identified database network element 26 based on the network over-view knowledge. An order (or command) may also be incoherent if it conflicts with another order (or command) made to that identified database network element 26 or conflicts with or must be processed in parallel with an order (or command) made to the same or to another database network element. These determined coherent, element specific commands are then formatted by action 52 in accordance with a certain format and protocol associated with each individual one of the identified database network elements 26 (such as a machine dependent language). In one implementation, the original machine independent order 40 is converted into a plurality of machine dependent commands 54 tailored to the identified database network elements. The interface 22 then issues the properly formatted device specific commands 54 to each of the implicated database network elements 26. Once an issued, properly formatted command 54 has been received by an identified one of the database network elements 26, that element processes the command in action 56 to effectuate the required service/subscription related activation or management task. Once the task has been completed, the database network element 26 sends a confirmation response 58 back to the interface 22. The agent 30 then stores the received response in action 60 in the database 32. The stored response accordingly becomes part of the database stored network over-view knowledge. The responses 58 are further compiled, if necessary, and any resulting response 62 is returned to the customer administrative system 24.

Reference is now once again made to FIGURE 2. Storage of network over-view knowledge in the interface 22 facilitates the more efficient offering of a number of services. First, a more efficient and comprehensive roll-back service may be offered as the stored network over-view knowledge is readily available at the interface 22 for its use in connection with directing roll-back to a prior state. Thus, there would be no need or requirement with the present invention for customer administration system participation in the roll-back activity. Furthermore, there would be no need in the present invention to have each database network element include specialized

functionality for supporting roll-back. The interface can accordingly operate to restore data in modified database network elements to former values. Second, a more efficient and comprehensive subscription audit service may be offered as the stored network over-view knowledge is readily available at the interface 22 for its use in auditing the network and responding to third party audit requests. Thus, there would be no need or requirement with the present invention for customer administration system participation in the auditing activity. The interface can accordingly audit the database network elements, and compare its subscriptions and subscription data to that actually stored in the network. Third, coherence checks of all orders (or commands) may be made before sending commands to individual database network elements. More particularly, as each subscription is now managed by the subscription handler interface of the present invention, all orders concerning that subscription are received by the interface and processed to detect and resolve conflicting or concurrent orders.

A number of other benefits arise from the implementation of the subscription handler interface of the present invention. First, each subscription is now modeled within the interface rather than within the customer administrative system. This architecture supports the use of a lightweight processing capability customer administrative system as the intelligence and processing functions now reside in the interface. Furthermore, through the network connection, the customer administrative system has direct access to the interface resulting in direct visibility over each subscription. Second, with network over-view knowledge maintained in the interface, it becomes a much easier task to coordinate dependent services support between multiple interfaces and multiple database network elements. Third, the interface, with network over-view knowledge, may offer a common abstract model at the customer administrative system rather than just reproducing the specifics of the individual database network element possibilities. This provides an enhanced facility for hiding the specificities (and differences) in the underlying network and database network elements from the customer administrative system. It further allows for data selection of certain values even if not directly supported by the specific database network element. Fourth, clients of the interface (not necessarily limited to the customer administrative system) may make enquiries and receive information concerning changes in status of a subscription being monitored by the interface. Fifth, clients of the interface (not necessarily limited to the customer administrative system) may obtain information concerning the status of time consuming tasks initiated by the interface (like service activation/deactivation or subscription data modification).

Although preferred embodiments of the method and apparatus of the present invention have been illustrated in the accompanying Drawings and described in the

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foregoing Detailed Description, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

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WHAT IS CLAIMED IS:

1. A system, comprising:

a customer administrative system operating to issue an order concerning a subscription management activity or task;

5 a plurality of database network elements of a communications system, the database network elements supporting individual services in relation to subscriptions; and

an interface between the customer administrative system and each of the plurality of database network elements, the interface including:

10 a database for storing network over-view knowledge in the form of a network model; and

a subscription handler service agent functionality responsive to the issued order for storing the order in the database as network over-view knowledge, identifying the subscription and related services implicated by the order, identifying the database network elements supporting those identified
15 certain individual services for the subscription, determining at least one device specific command for each of those identified database network elements to implement the requested subscription management activity or task, and performing a coherency check on the order and any determined device specific command in view of the network model to detect conflicting orders and
20 commands before issuance to the identified database network elements.

2. The system as in claim 1 wherein the communications network comprises a wireless telecommunications network and the database network elements comprise home location registers of the wireless telecommunications network.

25 3. The system as in claim 1 wherein the database stored network over-view knowledge for the network model comprises information defining relationships between subscribers, their subscriptions, any included and excluded services within each subscription, database network elements where service-related information is stored for each subscription, and a status of the subscription management activity or
30 task.

4. An interface between a customer administrative system and a plurality of database network elements of a communications network, the interface including a subscription handler service agent functioning to:

store network over-view knowledge in the form of a network model;

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receive an order concerning a subscription management activity or task;
store the order as network over-view knowledge;
identify the subscription and related services implicated by the order;
identify the database network elements supporting those identified certain
5 individual services for the subscription;
determine at least one device specific command for each of those identified
database network elements to implement the requested subscription management
activity or task; and
perform a coherency check on the order and determined device specific
10 command in view of the network model to detect conflicting orders and commands
before issuance to the identified database network elements.

5. The interface as in claim 4 wherein the communications network
comprises a wireless telecommunications network and the database network elements
comprise home location registers of the wireless telecommunications network.

15 6. The interface as in claim 4 wherein the agent function to determine
further functions to determine each device specific command in a machine dependent
language for the identified certain ones of the database network elements.

7. The interface as in claim 4 wherein the database stored network over-
view knowledge for the network model comprises information defining relationships
20 between subscribers, their subscriptions, any included and excluded services within
each subscription, database network elements where service-related information is
stored for each subscription, and a status of the subscription management activity or
task.

8. A method for interfacing a customer administrative system and a
25 plurality of database network elements of a communications network, the method
comprising the steps of:

storing network over-view knowledge in the form of a network model;
receiving an order concerning a subscription management activity or task;
storing the order as network over-view knowledge;
30 identifying the subscription and related services implicated by the order;
identifying the database network elements supporting those identified certain
individual services for the subscription;

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determining at least one device specific command for each of those identified database network elements to implement the requested subscription management activity or task; and

5 performing a coherency check on the order and determined device specific command in view of the network model to detect conflicting orders and commands before issuance to the identified database network elements.

9. The method as in claim 8 wherein the communications network comprises a wireless telecommunications network and the database network elements comprise home location registers of the wireless telecommunications network.

10 10. The method as in claim 8 wherein the agent function to determine further functions to determine each device specific command in a machine dependent language for the identified certain ones of the database network elements.

15 11. The method as in claim 8 wherein the database stored network overview knowledge for the network model comprises information defining relationships between subscribers, their subscriptions, any included and excluded services within each subscription, database network elements where service-related information is stored for each subscription, and a status of the subscription management activity or task.

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FIG. 1
(PRIOR ART)

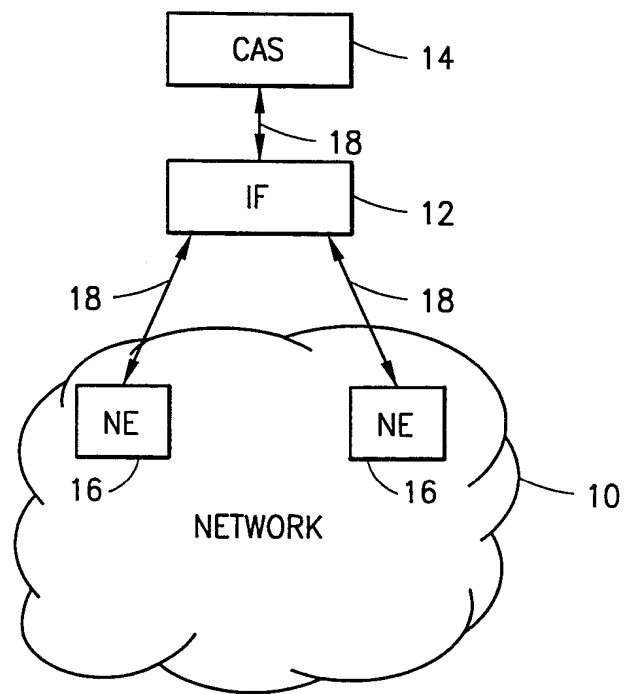
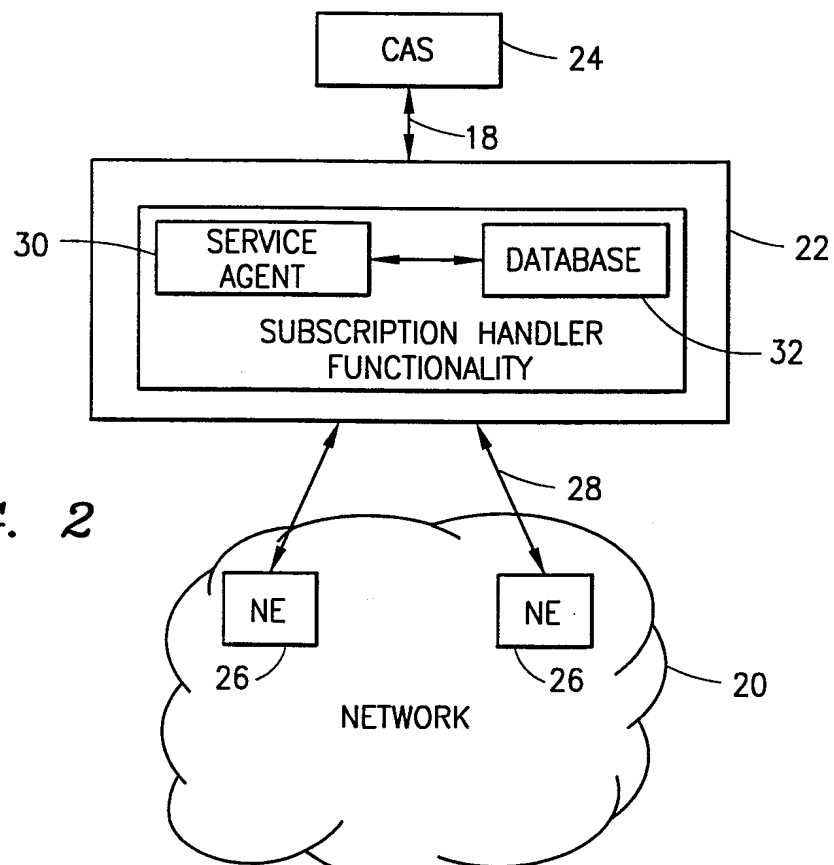


FIG. 2



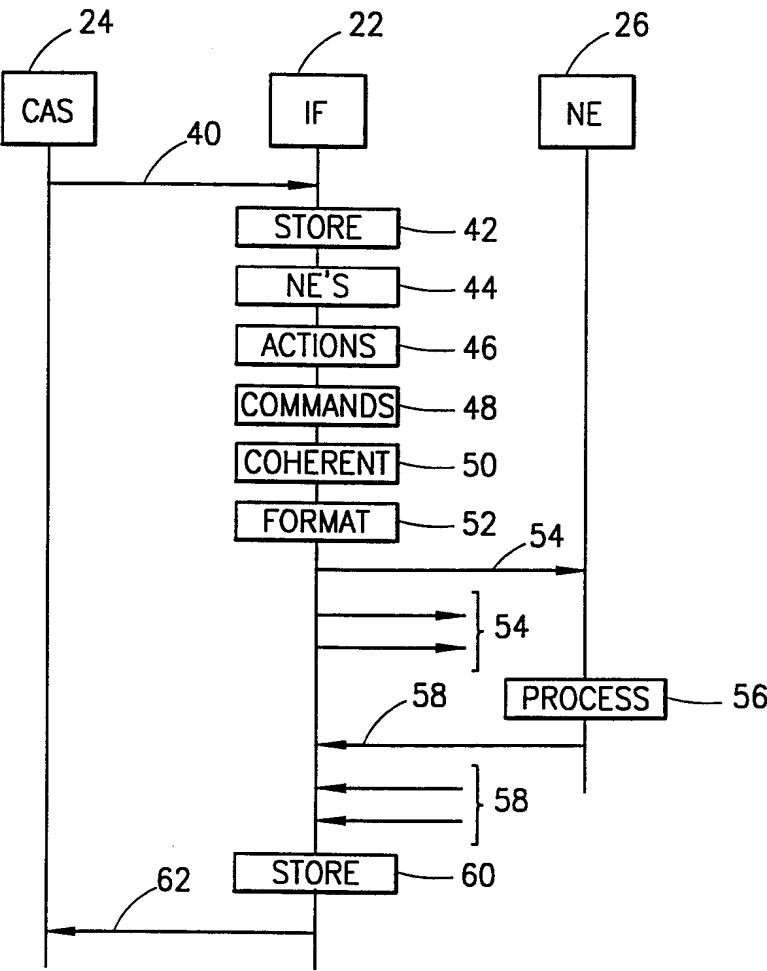


FIG. 3